

REMARKS

This application contains claims 1-17, 19-37, 39-57, 59 and 60. Claims 21-37, 39-57, 59 and 60 have been canceled without prejudice. Claims 1 and 10 are hereby amended. No new matter has been introduced. Reconsideration is respectfully requested.

With regard to the cancellation of claims 21-37, 39-57, 59 and 60, Applicant is not conceding that the subject matter encompassed by these claims was not patentable over the art cited by the Examiner. Claims 21-37, 39-57, 59 and 60 were canceled in this amendment solely to facilitate expeditious prosecution of the subject matter of claims 1-17, 19 and 20. Applicant respectfully reserves the right to pursue claims, including the subject matter encompassed by the claims as presented prior to this amendment and additional claims, in one or more continuing applications.

Claims 1-12, 18-32, 38-52 and 58-60 were rejected under 35 U.S.C. 103(a) over Yanai et al. (U.S. Patent 5,742,792) in view of Armangau et al. (U.S. Patent Application Publication 2004/0267836). In view of the prior cancellation of claims 18, 38 and 58, and the present cancellation of claims 21-37, 39-57, 59 and 60, the rejection of claims 21-60 is moot. Applicant respectfully traverses the rejection of the remaining claims.

Applicants have amended independent claims 1 and 10 to remove superfluous limitations from the claims. The claims in this application are believed to be patentable over the cited art with or without these limitations. Specifically, in a previous amendment, at the Examiner's suggestion, Applicant added the limitation that "the number of the predicted bits is chosen so as to achieve a desired balance between low average latency and rapid failure recovery": In an interview held with the Examiner by Applicant's representative, Sanford T. Colb,

on June 7, 2007, the Examiner stated that addition of this limitation to the claim would distinguish over Yanai. In the present Official Action, however, the Examiner declined to give this very limitation any patentable weight (see footnote on page 4 of the Official Action). Applicant has therefore deleted the limitation from the claims. Applicant respectfully suggests that prosecution of this application could be expedited if the Examiner were to take and maintain a consistent position with regard to the claim language.

Similarly, the limitation recited in claim 1 that the record maintained on the secondary storage subsystem is a bitmap record was also added at the Examiner's suggestion, based on agreement reached in a previous interview, held November 28, 2006, that the addition of this term would distinguish over the art that was cited at that time. In the present Official Action, however, the Examiner found that Armangau describes the use of bit maps in managing a data storage system and maintained that this feature of claim 1 is obvious. Applicant has therefore deleted the term "bitmap" from the claims in order to return to the more general formulation of the claims as originally filed in this application.

Claim 1 recites a method for managing a data storage system in which data are stored on non-volatile storage media in both primary and secondary storage subsystems. The method uses a record on the secondary storage subsystem that is predictive of locations to which data are to be written on the primary storage subsystem by a host processor. Upon receiving data from the host processor to be written to a specified location in the primary storage subsystem, and determining that the specified location is not included in the predictive record, the primary storage subsystem sends a message to the secondary storage subsystem. This message causes the secondary storage subsystem to update the record not only

to include the specified location for this write operation, but also to predict and add to the record one or more further locations to which the host processor is expected to write in a subsequent write operation but has not yet written data.

Yanai describes a remote data mirroring system, which stores data received from a host computer on a primary data storage system and copies the data to a secondary data storage system for providing a back-up copy (col. 2, lines 30-38). Both the primary and secondary data storage systems maintain a table of the validity of data in the each storage system (col. 11, lines 10-25). (An index is also maintained of pending format changes - col. 11, lines 25-30.) When a host computer writes data to the primary storage system, it sets both primary and secondary write pending bits in the table (col. 11, lines 31-34). These bits indicate that the host computer has written data to the cache, and that the controllers of the primary and secondary storage systems must now write the data to the respective storage devices, whereupon the bits will be reset (col. 11, lines 37-43).

Thus, there is nothing in Yanai's record that is even remotely predictive of locations to which a host is expected to write in the near future, as recited in claim 1. On the contrary, as shown above, Yanai's record relates only to locations to which his host computer has already written. Armangau fails to remedy this deficiency.

Armangau describes a snapshot copy facility that determines the difference between an older snapshot copy and a younger snapshot copy (abstract). This facility is used in copying modifications from a primary file system to a secondary file system using "delta chunks" (paragraphs 0079-0081). Armangau mentions hosts in passing (paragraph 0068), but provides no teaching or

suggestion whatsoever that these hosts might write anything to the file servers that hold his file systems. In other words, not only does Armangau fail to teach or suggest a predictive record of locations to which a host processor is expected to write: He does not relate to any sort of record at all of locations of host writes. Therefore, a person of ordinary skill in the art could not possibly have been motivated to incorporate teachings from Armangau into the records of host writes that Yanai maintains.

Furthermore, even if Armangau were considered, for the sake of argument, to be relevant to the invention of claim 1, he still fails to teach or suggest predicting further locations to which data are to be written, or setting a number of predicted locations in any sort of record. In regard to this element of claim 1, the Examiner cited paragraphs 0099 and 0243 in Armangau. Paragraph 0099 describes the use of two bit-map tables, indicating blocks in a primary file system volume that have been modified (i.e., new data have already been written to these blocks), which must therefore be copied on a priority basis to a save volume. Paragraph 0243 refers to a meta bit map, which indicates whether or not each allocated block of storage is valid or not. Armangau does not explicitly define what he means by "valid," but he uses the term to refer to blocks whose contents need not be saved (paragraph 0241). The indication of "validity" provided by the meta bit map therefore has nothing to do with either writing or prediction.

Thus, Yanai and Armangau together fail to teach or suggest the limitations of claim 1, and this claim is patentable over the cited art. In view of the patentability of claim 1, dependent claims 2-9, 19 and 20 are also believed to be patentable.

Independent claim 10 is similar to claim 1, with the added feature that the primary storage subsystem maintains a copy of the record on the secondary storage subsystem and uses the copy in determining whether to send the message. Claim 10 is therefore patentable, as well, for the reasons stated above with respect to claim 1. In view of the patentability of claim 10, dependent claims 11 and 12 are also believed to be patentable.

Furthermore, in rejecting claim 10 together with claim 1, the Examiner failed to mention or relate at all to the added feature in claim 10 of maintaining a copy of the record on the primary storage subsystem. In fact, this feature is neither taught nor suggested by the cited art. Therefore, claim 10 is independently patentable notwithstanding the patentability of claim 1.

Furthermore, notwithstanding the patentability of the independent claims, the dependent claims in this application recite subject matter that is independently patentable over the cited art. In the interest of brevity, however, Applicant will refrain from arguing the independent patentability of the dependent claims at present.

Dependent claims 13-17, 33-37 and 53-57 were rejected under 35 U.S.C. 103(a) over Yanai and Armangau in view of Dunham (U.S. Patent 6,269,431) and, with respect to some of the claims, further in view of official notice. As noted earlier, the rejection of claims 33-37 and 53-57 is moot in view of the cancellation of these claims. Application respectfully traverses the rejection of claims 13-17. In view of the patentability of independent claim 10, these dependent claims are believed to be patentable, as well.

Furthermore, with respect to claims 15-17, Applicant specifically traverses the Examiner's citation of "official notice" in finding certain claim limitations to be obvious. According to MPEP 2144.03(A), "Official

notice unsupported by documentary evidence should only be taken by the examiner where the facts asserted to be well-known or to be common knowledge in the art are capable of instant and unquestionable demonstration as being well-known." The Examiner has done no more, however, than repeat the added limitations of these dependent claims and then make a conclusory statement that the added limitations are obvious.

Specifically, claim 15 relates to removal of locations from the predictive record on the first and second non-volatile storage media, as recited in claim 13, and state that the locations removed are those at which the first and second non-volatile storage media contain substantially identical data and were least-recently added to the record. The Examiner stated that it would have been obvious to identify such locations since multiple copies of identical data need not be stored in multiple locations. This reasoning, however, runs diametrically against the whole purpose of redundant storage, in which the same data are systematically stored in both the primary and secondary subsystems, as is recited explicitly in the independent claims. Therefore, a person of ordinary skill in the field of the present invention would never have been inclined to reach the Examiner's conclusion with respect to claim 15.

Claim 16 recites grouping entries in the predictive record in generations on both the primary and secondary subsystems according to the order in which the entries were added to the record, and then determining at the primary subsystem that all the entries in one of the generations may be removed from the record. In regard to this claim, the Examiner's position appears to be that generations of entries are equivalent to "versions," and that it would have been obvious to discard such a "generation or version" using a "batch method." Even if it were conceded, for the sake of argument, that batch

deletions were known in the art, however, the Examiner has given no rationale as to why entries of locations in a predictive record might be considered "versions," or why the same "versions" should be grouped and then removed from both primary and secondary subsystems, as recited in claim 16.

Claim 17 recites that the very same message from the primary storage subsystem that instructs the secondary storage subsystem to update its record by setting a number of predicted locations in the record (as recited in claim 10) is also used in instructing the secondary storage subsystem to remove one or more locations. In his official notice with respect to this claim, the Examiner did no more than to restate the limitations of the claim itself, without giving any rationale at all as to why these limitations might be obvious, particularly in the context of the claimed invention. Applicant respectfully submits that the use of the same message to cause the secondary storage subsystem to predictively add locations and to remove locations from the record is not in any way obvious.

In view of the errors pointed out above in the Examiner's rejection of claims 15-17, Applicant respectfully requests that the Examiner provide documentary evidence or an affidavit setting forth specific factual statements and explanation to support his findings, as required by 37 CFR 1.104(c)(2) or 37 CFR 1.104(d)(2), or otherwise allow these claims. (See MPEP 2144.03(C).)

Applicant believes the amendments and remarks presented above to be fully responsive to all of the grounds of rejection raised by the Examiner. In view of these amendments and remarks, all of the claims now pending in this application are believed to be in condition for allowance. Prompt notice to this effect is requested.

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